TEXTILE REINFORCEMENT LAYER FOR HOSES, TUBES AND SIMILAR EXTENDED OBJECTS AS WELL AS FOR PRODUCTS MANUFACTURED FROM SUCH OBJECTS

The invention concerns a textile reinforcement layer for hoses, tubes and similar extended objects, that comprise at least one inner layer, the textile reinforcement layer and an outer layer bonded to the textile reinforcement layer and the inner layer as well as with the aforementioned products manufactured with the use of such textile reinforcement layer. This invention is especially concerned with those hoses or tubes reinforced with a textile product that are bent and/or give evidence of a big variation in diameter along their length, for example, the type of hose used in motor vehicles, in order to connect a turbocharger with an air load cooler or with the air intake of the corresponding combustion engine.

Tubes and hoses that have bends and/or big diameter variations, that due to stability reasons are provided with a textile reinforcement layer, are generally manufactured in the following way: First, one manufactures an inside tube of the desired form and shape, then the textile reinforcement layer is applied to the inside layer, and finally, an outer layer is applied, generally at high temperatures in order to obtain an intimate bond between the inner layer, the textile reinforcement layer and the outer layer. The material of the inner layer and the outer layer therefore builds a matrix in which the reinforcement layer is then embedded.

Of course, one could use several layers, instead of a single reinforcement layer, in which case an intermediate layer of matrix material may be applied between the

The main problem in the production of hoses and tubes by machine is the wrinkle free application of the textile reinforcement layer. Many times a wrinkle forms in the textile reinforcement layer when the flat textile product is introduced into hose or tube products. This may generate an area where the reinforcement layer does not overlap the inner layer or does so only imperfectly. It is clear that the properties of the product are enormously compromised through these defects. In the case of tubes or hoses with big variations in diameter, the problem is that the less elastic the structure of the textile reinforcement building material is, the less it is inclined to conform to these great diameter variations. The problem is especially noticeable in highly inflexible materials such as aramid fibers, fiberglass, carbon fibers, metallic fibers as well as cellulose fibers.

In order to allow the textile reinforcement layer to expand in the direction of the radius, and thus to conform to the difference in diameters, the textile reinforcement products are often manufactured in a "condensed" state, i.e. compressed significantly in the direction of the radius. Such condensed textile products can be applied by a machine on the inner layer of the object to be reinforced only with difficulty, or not at all, since, during the introduction of the initially flat textile product into, for example, a hose or a tube, there could be an uncontrollable material accumulation in some areas on the one hand, as described above, and also on the other hand no textile reinforcement layer at all in other areas.

In order to avoid defects such as this, this reinforcement layer is often still applied by hand on the inner layer of the tube or hose. The reinforcing layer of material is many

attempt was made to apply this reinforcement layer by machinery, the textile material

used, often a knit material, was excessively condensed, as described above, and therefore too heavy, which led to the previously discussed problems of an uneven application. Moreover, these textile products are very expensive.

The invention has the objective to produce a textile reinforcement layer that is useful on hoses, tubes and similar extending objects, and that can also be easily machine applied on the inner layer of the object to be reinforced. In its further development, this invention will also enable the reinforcement layer to conform to big variations in diameter without problems.

This objective has been achieved in this invention by using a material in the textile reinforcement layer, which acts to stiffen the layer at least in a direction different from the longitudinal axis of the object to be reinforced, specifically perpendicular to that axis. In this way, namely by a reinforcement essentially perpendicular to the axis, the reinforcement layer can be applied easily by machine on the inner layer of the object to be reinforced, because it can be transformed from a flat shape into the shape of the body to be reinforced without wrinkles, perhaps through guiding the reinforcement layer through a conical narrowing opening of the corresponding form.

In a preferred further development of the invention, the reinforcement material loses its stiffness at higher temperatures, such as will occur, for example, during the bonding of the outer layer with the textile reinforcement layer and the inside layer. The stiffening feature of this invention provides the textile reinforcement layer with the desired perpendicular stiffness, where this perpendicular stiffness will not subsequently

of the object to be reinforced in an undesirable manner.

In order for the textile material to lose its stiffening properties, the melting point of the stiffening material may be lower than that of the reinforcement layer material, so that the stiffening material melts when the outer layer is bonded to the inner layer and the reinforcement layer at high temperatures. It is not required that the stiffening material will liquefy during the application of the outer layer, rather it is sufficient that the stiffening material, in spite of its stiffening action, be either adequately elastic or due to the rise in temperature remain plastic enough so that the reinforcement layer can conform to the changes in diameter of the object to be reinforced without difficulty.

In the simplest of cases, the stiffener consists of individual fibers or threads, that stretch in such a way that the textile reinforcement layer stiffens in a perpendicular direction. For example, the threads or fibers may run diagonally to the longitudinal axis of the reinforced object, but can also run perpendicular to it.

The stiffening may also be a textile product, for example, a fabric, a knitted fabric, a knit, a double knit, a fleece, etc.

According to an alternative execution, the stiffening comprises at least one foil. For example, the reinforcement textile material can be pasted onto a foil or in between two foils. The foil can be of a thermoplastic material, of heat hardened synthetic material, or even of metal. The foil can, if the material is appropriate, be extruded together with the textile reinforcement layer.

According to a modified form of the present invention, one or more of the aforementioned foils can be used instead of the textile reinforcement layer. Under this

through the use of this foil or these foils.

The previously mentioned methods for achieving stiffness may also form a textile bond with the textile reinforcement layer. For example, the reinforcement layer can be bonded onto a double knit of individual threads or fibers that achieve the stiffening. As an alternative, the threads or fibers of the textile reinforcement layer itself can be made of a material that achieves the desired stiffness. Therefore, the textile reinforcement layer can consist of a primary material consisting of threads, fibers or yarns with a high tensile strength, which produces the strengthening effect, and moreover, can be made of a secondary material consisting of threads, fibers or yarns that are less stable with regard to temperature and that produce the desired stiffness. Also, the foil which forms the stiffening could be woven into the textile reinforcement layer. Regardless of whether or not there is a textile bond between the reinforcement layer and the stiffener, the cohesion between the textile reinforcement layer and its stiffening must be so stable that it does not separate during the machine application on an inner layer of the object to be reinforced.

In another form of the invention, the stiffener is a chemical that is absorbed by the textile reinforcement layer material. The textile reinforcement layer material can, for example, be immersed in this chemical, which in turn dries and solidifies, and therefore stiffens the reinforcement layer.

Independently of the chosen form of stiffening, this should primarily enhance the perpendicular stiffness of the textile reinforcement layer. It is entirely harmless and sometimes even desired that there also be a stiffening of the textile fibers in the longitudinal direction, since this does not interfere with the application and disappears

The material comprising the stiffener may, for example, be similar to one of the textile reinforcement layer materials, such as a polymer or copolymer. It is desirable that the matrix material (appropriately modified) or a related material be used as the stiffening material. This can be done in the forms listed above, or in a solution to be applied to the reinforcing layer.

Materials that are appropriate are polyacetates, polyethylene terephthalate, polybutylene terephthalate, caprolactames and other synthetic materials.

By means of this invention, every textile reinforcement surface can thus be stiffened temporarily. The textile reinforcement layer that is favored is a knit, but can also be a fabric, knitted fabric, double knit, fleece, or any other textile product. The stiffening due to this invention enhances the stability of the reinforcement layer in a direction that differs from the longitudinal axis of the object to be reinforced, regardless of direction, and preferably in a perpendicular direction, for at least as long until the outside layer or the next layer of matrix material is bonded under the effects of temperature. Therefore, the invention makes it possible, that extended objects, consisting of an inner layer, an attached textile reinforcement layer and an outer layer, can be machine extruded in a single pass, and if necessary, can be adjusted to conform to large changes in diameter (perhaps to 1:2.2).